PILOT CONTROL PROJECT OF CARBARYL, TRICHLORFON, AND *BACILLUS THURINGIENSIS* AGAINST WESTERN SPRUCE BUDWORM BEAVERHEAD AND GALLATIN NATIONAL FORESTS, MONTANA 1975

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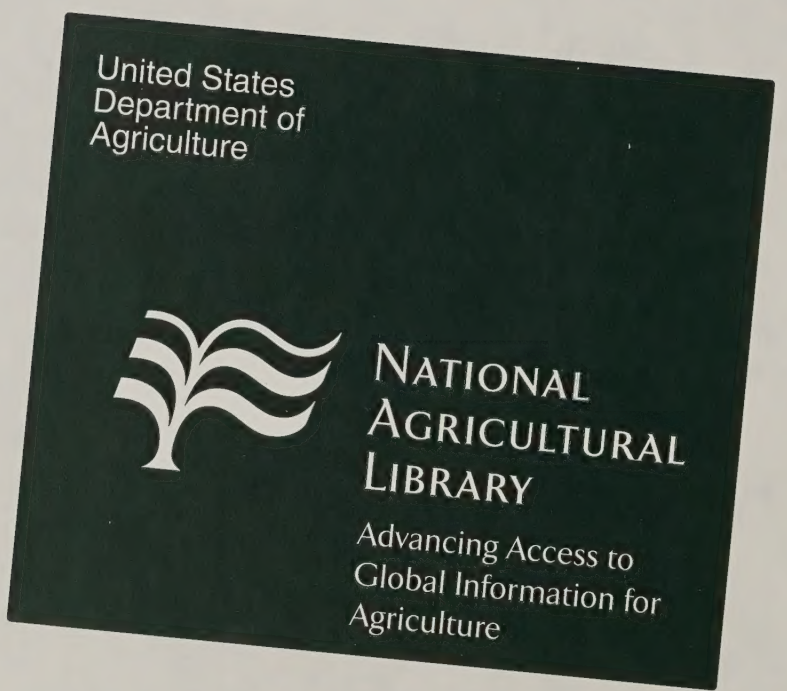
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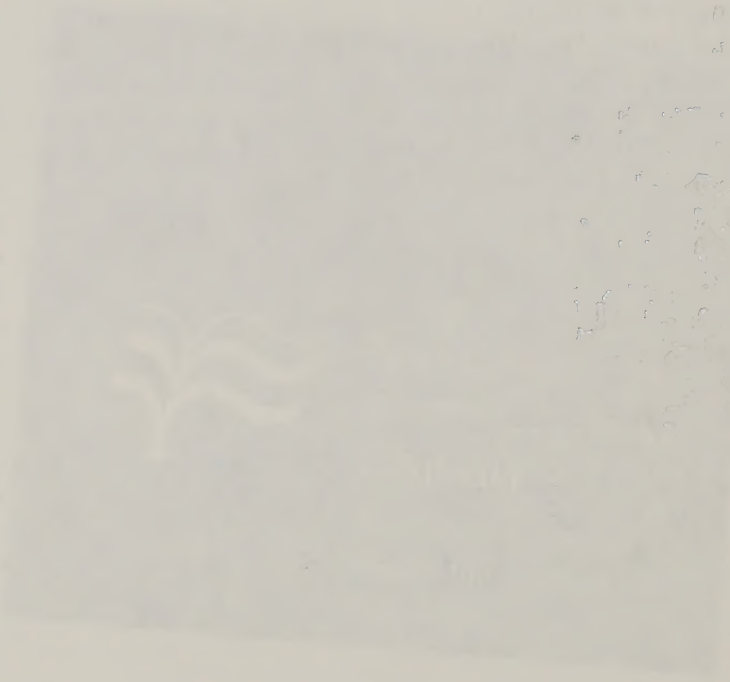

INTRODUCTION

Western spruce budworm, *Choristoneura occidentalis* Free., has long been recognized as one of the most damaging defoliators of the Douglas-fir-true fir forests of the Western U.S. It has been the target of many large-scale control projects. Currently the land manager has few options for chemical management of budworm infestations. The once widely used insecticide DDT has been banned for forest spraying; mexacarbate (Zectran), an insecticide currently registered for budworm management, has given quite erratic results, and is no longer being manufactured; and malathion, the other insecticide registered for budworm management, has given quite erratic results and is in short supply. Because of this situation the Forest Service has seen fit to engage in an extensive nationwide pilot control program of promising chemical and microbial insecticides against spruce budworm in 1975. The ultimate objective is to provide sufficient data to support EPA registration of one or more materials to provide resource managers with action alternatives for management of budworm infested forests. It is important to have more than one insecticide available, for each material has different properties, and different materials will be more acceptable in different situations; e.g., sensitive areas, areas of heavy rainfall, etc.

The insecticides scheduled for pilot control projects against budworm in the West in 1975 are:

1. Carbaryl (Sevin-4-Oil)
2. Trichlorfon (Dylox)
3. *Bacillus thuringiensis* Berliner (Dipel)
4. Fenitrothion

These materials were selected for pilot control projects because they have been quite extensively laboratory and field tested in the U.S. and/or Canada and show promise of being effective and environmentally acceptable in many situations.

Region 1's participation in this nationwide program will include pilot control projects of Sevin-4-Oil, Dylox, and Dipel.

OBJECTIVES OF PROJECT

The objectives of the 1975 Sevin-4-Oil, Dylox, and Dipel pilot control project are:

1. To evaluate and compare the effectiveness of an aerial application of Sevin-4-Oil, Dylox, and Dipel in reducing budworm populations under operational conditions.
2. Measure effect of the treatments in protecting foliage, both the year of treatment and the following year, when only relatively small portions of an infestation are sprayed.
3. Identify and resolve problems in formulation and application of large volumes of these materials.
4. Determine effect of these treatments on western spruce budworm parasites.

5. Evaluate the effect of treatments on water quality and non-target organisms, i.e., birds, fish, aquatic invertebrates, and insect pollinators.

6. To measure residue levels, over time, on selected grasses, herbaceous forage, and Douglas-fir foliage.

PROJECT LOCATION

The chemical (Sevin-4-Oil and Dylox) phase of the project will be conducted on the Madison and Sheridan Ranger Districts of the Beaverhead National Forest (Figure 1). This is a young outbreak that appears to be very vigorous. Egg mass counts are high, averaging over 23 new egg masses per 1,000 square inches of foliage (Tunnock, et al., 1975).

The microbial (Dipel) phase of the project will be located on the Gallatin District, Gallatin National Forest (Figure 2). The outbreak on the Gallatin was detected in 1971 and has increased in acreage and intensity since then. The fall 1974 egg mass survey on the Gallatin District shows 15.9 new egg masses per 1,000 square inches of foliage (Tunnock, et al., 1975).

Selected streams will be within some of the spray and check plots as a part of the environmental monitoring program.

MATERIALS AND METHODS

Materials to be evaluated.--Sevin (carbaryl), a carbamate insecticide, is a product of Union Carbide Corp. It is widely used in forestry and agricultural spraying. One of its registered forestry uses is to control various species of tent caterpillars, gypsy moth, elm leaf beetle, and others. In field experiments Sevin-4-Oil has been shown very toxic to budworm larvae (Hildahl and DeBoo, 1973; Dimond, 1974; Beach and Dolan, 1973). Sevin-4-Oil will be formulated (diluted 1:1 with diesel oil) and applied at 1 pound of Sevin in enough carrier (oil) to make 1/2 gallon per acre.

Dylox is a short-lived organo-phosphate insecticide manufactured by Chemagro Corporation. The formulation to be used in this project is 1 pound of Dylox in enough Panasol AN3 (a petroleum solvent) to make 1 gallon total material per acre. Dylox has been field tested against budworm in both Canada (Kettela, 1974; Randall, 1970), and the U.S.,[1/] and given encouraging results.

Dipel is a product of Abbott Laboratories. Active ingredient is the aerobic spore-forming bacterium *Bacillus thuringiensis*. This pathogen is infective to numerous lepidopterous (butterflies and moths) larvae. Some of the forest insects that Dipel is registered for are tent caterpillars, fall webworm, gypsy moth, and elm spanworm. Laboratory and field experiments show Dipel to be quite toxic to spruce budworm (Tripp,

1/Per memo from U.S. Forest Service Region 5 to U.S. Forest Service, Washington, D.C.

d. Evaluate the effect of treatment on water quality and non-target organisms, i.e., birds, fish, aquatic invertebrates, and insect pollinators.

e. To measure residue levels, over time, on selected grasses, herbaceous forage, and Douglas-fir foliage.

PROJECT LOCATION

The chemical (Sevin-4-Oil and Dylox) phase of the project will be conducted on the Madison and Sheridan Ranger Districts of the Beaverhead National Forest (Figure 4). This is a young outbreak that appears to be very vigorous. The egg counts are high, averaging over 21 new egg masses per 1,000 square inches of foliage (Tunnock, *et al.*, 1975).

The microbial (Dipel) phase of the project will be located on the Gallatin District, Gallatin National Forest (Figure 5). The outbreak on the Gallatin was detected in 1971 and has increased in acreage and intensity since then. The fall 1974 egg mass survey on the Gallatin District showed 15.9 new egg masses per 1,000 square inches of foliage (Tunnock, *et al.*, 1975).

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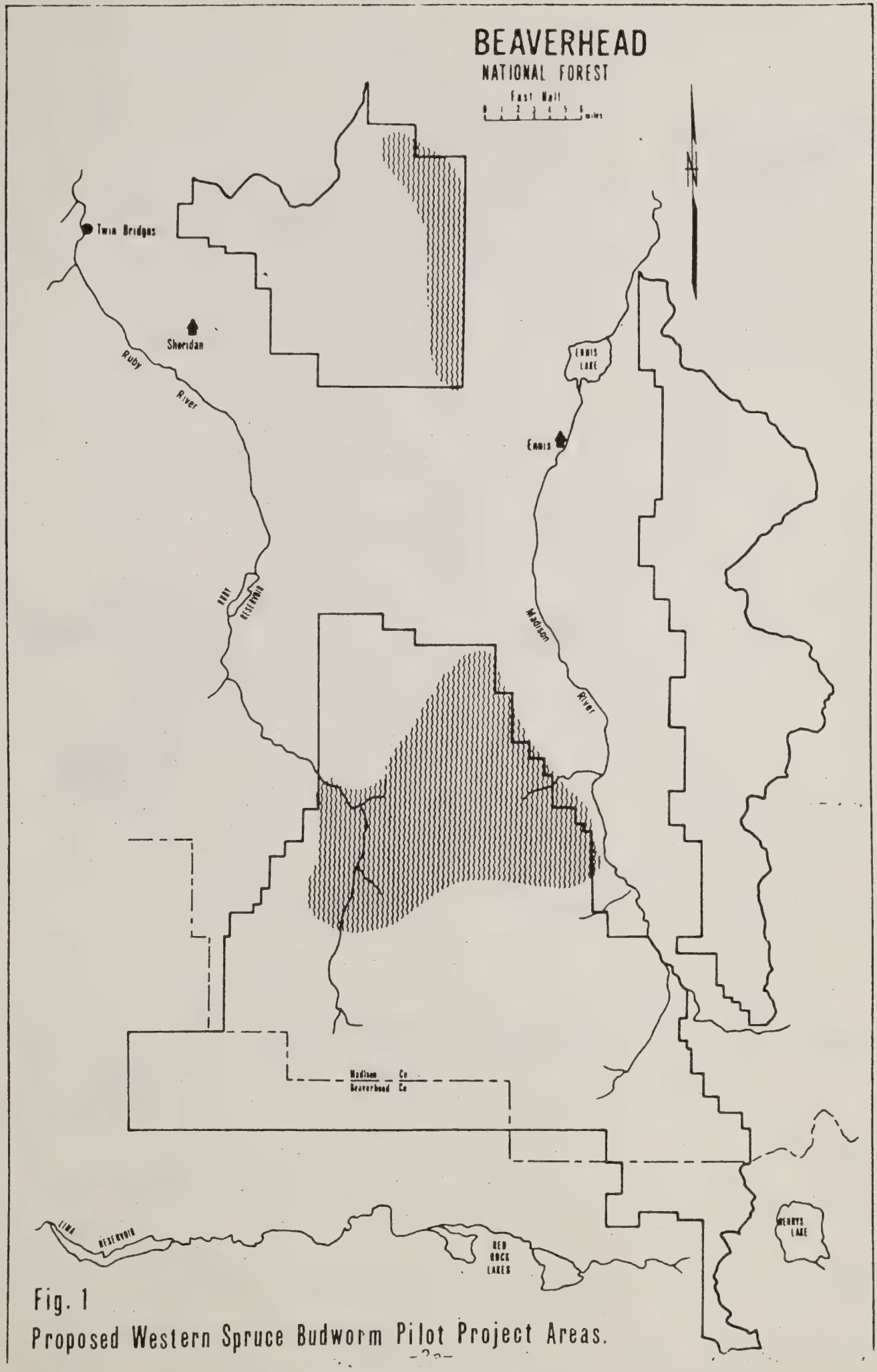

Fig. 1
Proposed Western Spruce Budworm Pilot Project Areas.

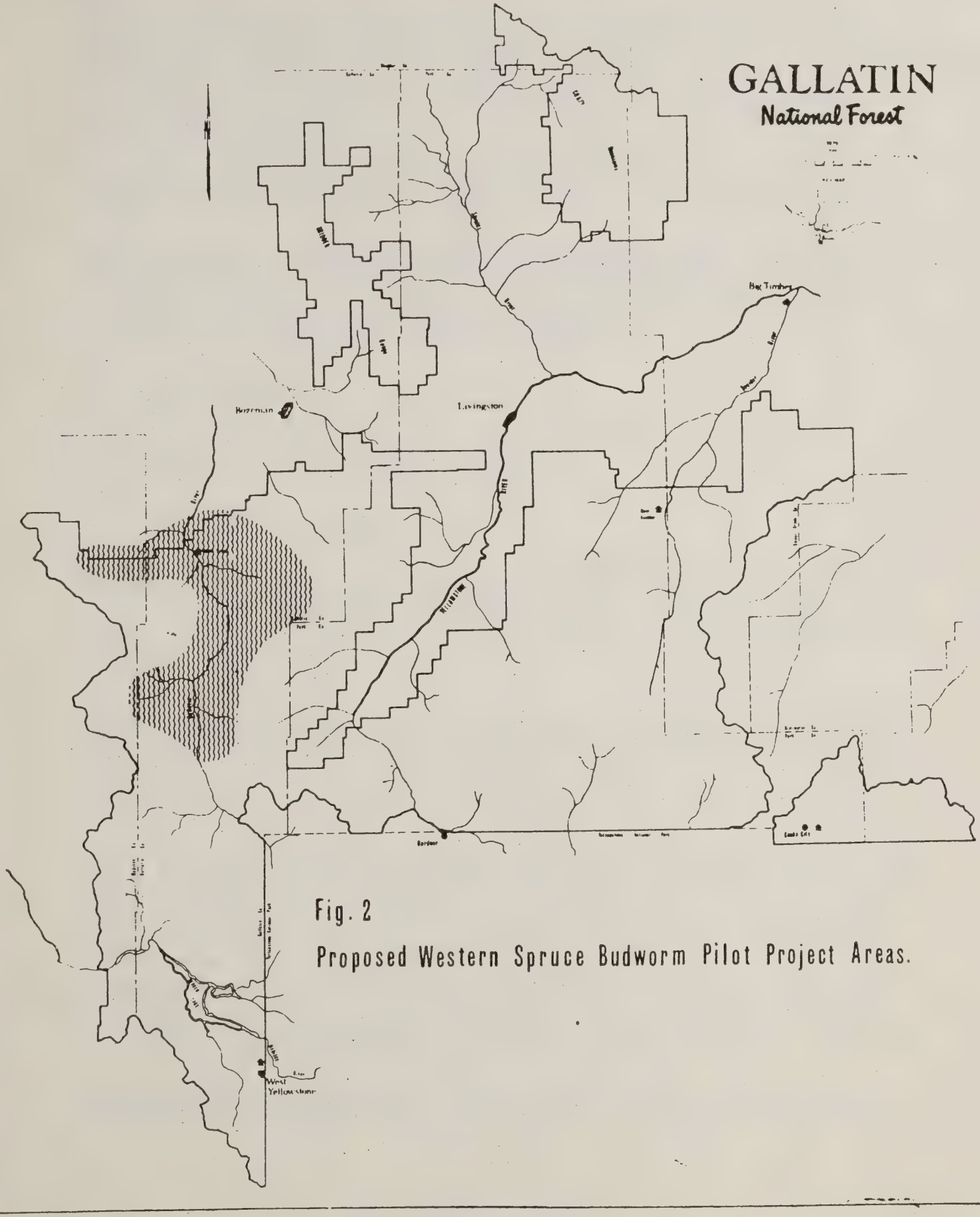

Fig. 2

Proposed Western Spruce Budworm Pilot Project Areas.

1972; Smirnoff, et al., 1973). Concentration of Dipel to be evaluated in this pilot control project is 1 pound in 2 gallons of water per acre. A commercial surfactant, Biofilm, will be added at the rate of 16 ounces per 100 gallons of spray. This material enhances the effect of Dipel by causing the spray droplet to form a thin film on the needle surface rather than to bead up.

A dye for assessing spray deposit will be added to the formulations at a concentration sufficient to leave a distinct mark on a white spray deposit card.

Project design.--A completely random experimental design will be used on each area. This will consist of three treatments replicated three times on the Beaverhead, and two treatments replicated three times on the Gallatin. The treatments for the Beaverhead are:

1. Sevin-4-Oil
2. Dylox
3. Unsprayed check

The treatments for the Gallatin include:

1. Dipel
2. Unsprayed check

Each treatment will be applied to plots ranging from 1,000 to 2,000 acres in size depending upon topography and availability of sample trees. Spray plots will be separated by at least 1 air mile to prevent contamination from other spray plots. Treatments will be assigned randomly in each area.

Budworm development sampling.--A critical part of any project is timing of spraying to coincide with the most susceptible stage of insect development. For this pilot control project, a plot will be sprayed when 90 percent of the larvae have reached fourth, fifth, and sixth instars in that plot. This is expected to occur in late June or early July.

Larval development will be systematically measured beginning shortly after diapause is broken. Two 15-inch branches from each of three trees will be collected from at least 10 widely separated locations within each treatment plot. Development samples will be collected every other day per plot until development exceeds 50 percent fourth, fifth, and sixth instar, then samples will be collected daily. Branches will be bagged and taken to the laboratory where all larvae will be extracted and placed in alcohol. Larvae will be separated according to instars by an entomologist or trained technician. Instar determination will be based on physical characteristics of the larvae.

Budworm population sampling.--The population sampling system was developed from the computer program MUST, which utilizes multistage variance

[illegible] et al., 1973). A [illegible]
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A [illegible] Plum Island, will be [illegible]
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1. [illegible]
2. [illegible]

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[illegible] area.

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[illegible] cent of the larvae have reached [illegible]
[illegible] plot. This is expected to occur in late [illegible]

[illegible] development will be systematically [illegible]
[illegible] is broken. Two 15-inch branches from each [illegible]
[illegible] be collected (see at least 10 wide) [illegible]
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[illegible] plot until development exceeds 50 percent; then [illegible]
[illegible] , then samples will be collected daily. [illegible]
[illegible] and taken to the laboratory where all larvae [illegible]
[illegible] in alcohol. Larvae will be separated according [illegible]
[illegible] by trained technicians [illegible]
[illegible] physical characteristics of the larvae.

Population sampling.--The population sampling [illegible] is devel-
[illegible] computer program [illegible], which utilizes [illegible]

estimates and different costs to determine sample size for each sample stage. From this information the investigator can select the level of precision best suited to his objectives.

Budworm population samples will be collected from tree clusters. Twenty-five clusters of three trees each will be identified in each treatment area. Both prespray and postspray population estimates will be taken from these trees. Sample trees are defined as Douglas-fir, 30 to 50 feet tall, open grown, and not shielded by larger trees.

Trees suitable for sampling budworm are not evenly distributed over the treatment area; consequently, a truly random or systematic means of selecting sample trees is impractical. Therefore, sample trees will be selected to provide a representative sample over each area to the extent that vegetational types within each area permit.

The prespray population will be measured by collecting two approximately 15-inch branches from midcrown of each sample tree. In the laboratory the number of current year's shoots or buds per branch will be counted as well as the number of budworm larvae per branch. The population estimate will be expressed as budworm larvae per 100 new shoots or buds.

The postspray population sample is identical to the prespray except four branches will be collected per postspray sampling period instead of two. Extra postspray branches are collected because of the greater variability found with low population levels anticipated as a result of treatment.

Prespray population samples will be collected within 48 hours prior to spraying. The postspray sampling schedule will vary with the material used because of differences in residual life of the materials.

The postspray sample in Dylox treatment plots will be collected 7 days after spraying. This chemical is so short-lived that all treatment effects should be realized by this time.

Sevin-4-oil and Dipel have a field residual life of about 2 to 4 weeks. Postspray population samples will be collected at 7-, 14-, and 21-day periods following treatment. The 7- and 14-day samples are designed to determine how quickly treatments are effective. The 21-day sample is to provide a final estimate of treatment effect upon the target insect and its parasites.

Though some residual insecticide may persist beyond 21 days, western spruce budworm should be completing its larval cycle by this time.

Collection of samples.--Prespray and postspray samples will be collected by two persons working as a crew. The same crew will collect all prespray and postspray samples from assigned clusters of trees.

Samples will be collected by one crew member raising a telescopic pole pruner, with catch bag attached, into the midcrown portion of the sample tree and clipping the 15-inch branch in such a way that it falls into the catch bag. The pole is then lowered and the sample branch and any material in the bag is bagged and taken to the laboratory for measuring and counting.

Laboratory procedures.--A field laboratory will be located in the Bozeman vicinity for the Dipel phase of the project and in Ennis for the Sevin-4-Oil and Dylox phase.

All branch samples will be taken to the laboratory the same day they are collected and immediately placed in refrigeration until they are examined. All samples will be examined within 48 hours of collection.

A crew of trained examiners will remove larvae, pupae, and parasites from foliage and place them in petri dishes (with camel hair brushes).

An entomologist will separate different species of larvae. All budworm larvae will be counted and placed in petri dishes for rearing to determine percent parasitism and identify the parasite complex. No more than 10 larvae, all from the same tree, will be placed per petri dish and reared on an artifical diet.

The number of buds (1975 shoots) will be counted for each branch sample.

Meteorological measurements.--Meteorological support will be provided by the Department of Defense, Dugway, Utah. They will provide local area forecasting and monitor wind, temperature, and humidity during all spray operations.

Spray application (equipment and timing).--Spray will be applied with helicopters. The spray system will have circulation or agitation in the tank and be capable of maintaining pressures of near 50 pounds per square inch. Boom length and nozzle configuration will be such as to obtain the specified dosage rates and droplet size. Swath width at tree top height will be 50 to 100 feet at a release height of 50 feet above the tree tops, depending on helicopter type.

Spraying will be done during the early morning hours when the air is cool and still. Spraying will be terminated when winds exceed 6 miles per hour at ground level in clearings or temperatures are over 65 degrees. One plot (one-third of a treatment) will be sprayed per day per area.

Spray deposit assessment.--Four white print-flex spray deposit cards will be placed around each sample tree to assess spray deposit. Another 50 cards will be located in an open area in each plot. Cards will be stationed no more than 18 hours prior to spraying and picked up immediately after an area has been treated.

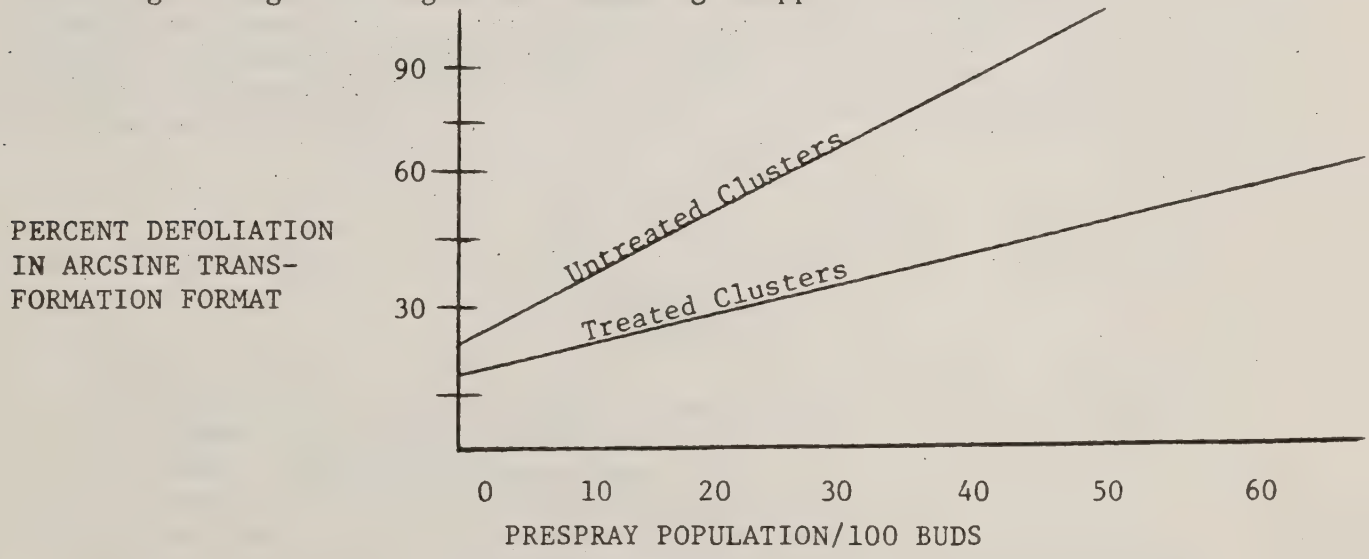
The dye Automate Red B will be added to the oil base sprays (Sevin and Dylox) at the rate of 2 percent by volume. Rhodamine B extra S will be the dye added to the water base spray at the rate of 1.25 grams per liter.

The spray deposit cards will be analyzed for percent spray deposit and volume median diameter (v.m.d.) of the spray droplets by the Department of Defense, Dugway, Utah.

Assessing treatment effect on foliage protection.--Because the spray is applied to relatively late instar larvae, the amount of current year's foliage protected will be minimal. It is expected that problems may occur in assessing the carryover effect of treatments on foliage protection the following year due to the small size of the plots and the ability of budworm moths to reinfest an area. Yet it is considered advisable as a part of this project to assess amount of foliage saved as a result of treatment, both the year of treatment and the year following treatment.

The amount of current year's foliage saved will be measured by collecting four midcrown branches from each sample tree after all feeding has been completed. Defoliation to the nearest 10 percent will be estimated on 25 apical shoots on each branch. Mean percent defoliation for each tree will be determined. Defoliation the following year will be measured in the same manner on the same trees to evaluate carryover effect of the treatment.

To measure current year's foliage saved a covariance analysis will be used to test significant differences of slope and intercept between untreated and treated clusters where the independent variable is the prespray population and the dependent variable is the percent defoliation in arcsine transformation format. If the treatment was effective in saving foliage the regression line might appear as shown below:



To measure foliage saved 1 year after treatment, an analysis of variance in a completely randomized block design will be used to compare differences of defoliation between check and treated plots if such differences occur. Another possibility is to use a multiple covariance analysis to detect differences in defoliation.

The budworm population will be remeasured in each plot at a time corresponding with the prespray sample the year following treatment (1976), to determine if larval populations remain low in treated plots compared to checks.

Data analysis.--Application effectiveness will be evaluated by a comparison of postspray or residual larval densities among treated and untreated plots. Analysis of covariance in an experimental design will be used. Comparability will be maintained through an adjustment of postspray population means ($\bar{Y}_n$) to minimize effect due to variation among prespray larval densities, and covariate ($\bar{x}_i$). Comparability among independent covariates will be provided by measuring prespray population densities at the same stage in larval development.

Estimates of larval densities per plot will be computed for each sampling period and denoted as follows:

x_i = prespray larval density.
y_n = n^{th} postspray larval density.

Measurements of budworm larval density will be made from population counts expressed as a number of larvae or pupae per 100 shoots. Larval densities will be calculated for each branch sample. Mean larval densities for each plot will be calculated in a multistage context (Hazard and Stewart, 1974); i.e., larval densities over branches, trees, and clusters as follows:

$$\bar{\bar{y}} = \frac{\sum_{l=1}^{n} \sum_{j=1}^{m} \sum_{l=1}^{k}}{nmk}$$

$\bar{\bar{y}}$ = per plot mean larval density computed over all sample stages
n = number of clusters (first-stage unit)
m = number of trees (second-stage unit)
k = number of branches (third-stage unit)
yijl = an observation (budworm larvae per 100 shoots) of the i^{th} third-stage unit within the j^{th} second-stage unit within the i^{th} first-stage unit.

Mean larval densities will be listed in the following format and analyzed in an analysis of covariance computer program (Table 1). Postspray larval densities will be adjusted ($\hat{y}_i$) and corresponding F test performed. Test significance will be considered at p = .90, highly significant at p = .95, and very highly significant at p = .99.

Table 1.--List of prespray and postspray larval densities means for treatments and replications.

Plots (Reps)	Treatments							
	A Sevin-4-Oil		B Dylox		C Dipel		D Untreated check	
	$\bar{\bar{x}}_i$	$\bar{\bar{y}}_n$	$\bar{\bar{x}}_i$	$\bar{\bar{y}}_n$	$\bar{\bar{x}}_i$	$\bar{\bar{y}}_n$	$\bar{\bar{x}}_i$	$\bar{\bar{y}}_n$
1								
2								
3								

Corrected percent control can be expressed using Abbott's modified formula which takes into account unequal sample sizes and natural population reduction.

$$\text{Percent Control} = 1 - \frac{TA \times CB}{TB \times CA}\ (100)$$

Where TA = postspray population treatment mean
TB = prespray population treatment mean
CB = prespray population control mean
CA = postspray population control mean

An analysis of the spray deposit data will be made to determine the relationship between spray coverage and budworm mortality. Standard linear regression analysis will be used to compute regression and correlation coefficients. Significances of regression slope will be tested by an analysis of variance.

Data analysis will be done for both individual trees and 3 tree clusters for each treatment plot. Spray deposit data in gallons per acre (independent variable x) and larval mortality (dependent variable y) will be transformed (by log probits or logit scales) to change the Sigmoid curve characteristics of the relationship between the dosage and mortality to a straight line (Maksymiuk, 1963).

ENVIRONMENTAL MONITORING

Monitoring pesticide residues and the effects of a pesticide application on nontarget organisms must be an integral part of any pest management operation. Expected environmental impacts of a treatment is mandatory information for a resource manager to consider in deciding for or against operational control. The pesticide and its potential for adverse environmental effects will dictate the degree and complexity of monitoring required.

The goals of the monitoring program are:

1. To determine the biological effects, or their absence, of the three insecticides on key environmental parameters in the forest environment if unknown from previous forest monitoring studies.
2. To quantify residue accumulation and degradation of the insecticides applied in key environmental parameters if unknown from previous forest monitoring studies.

Monitoring parameters.--The proposed monitoring program has been designed for both biological effects and residue monitoring. The residue monitoring program will include the collection, analysis and evaluation of samples from water, aquatic insects, fish, and vegetation. Biological monitoring will include effects on western spruce budworm parasites (number and diversity), aquatic insects (benthic and drifting), insect pollinators, fish, and insectivorous birds. Table 2 shows the key parameters to be monitored for each material.

Table 2.--Key monitoring parameters

	Material	Dylox	Sevin-4-Oil	Bt
Residue	Water		X	
	Aquatic insects		X	
	Fish		X	
	Douglas-fir foliage		X	
	Grasses		X	
	Herbaceous forage		X	
Biological effects	Parasites	X	X	X
	Benthic insects	X	X	X
	Drifting insects	X	X	X
	Insect pollinators	X	X	
	Fish	X	X	X
	Insectivorous birds	X	X	

Monitoring coordination.--The monitoring program will be conducted by the Forest Service and other Federal and State agencies. Study plans will be developed by investigators under guidelines developed by the Forest Service. Study plans will be approved by the Project Director and Monitoring Coordinator.

Pesticide residue analysis will be contracted to a single laboratory so standard methods for sample preparation, analysis, interpretation, and reporting of the data may be made. Residue analysis data will be provided to cooperators for further analysis and interpretation in the biological effects phase of the program. The residue analysis contract will be directly negotiated and funded by the Forest Service.

The following guidelines have been developed for the monitoring program:

Aquatic Resources[2/]

Objective: Determine the effects of Sevin-4-Oil, Dylox, and Dipel on aquatic invertebrates and vertebrates in perennial streams within the treatment plots. Water quality (alkalinity, dissolved oxygen, conductance, and temperature) will be measured during the application period.

Methods: Three benthos monitoring stations will be established on each sample stream flowing 5 to 10 cubic feet per second. Benthos samples will be secured by the kick sample technique. Benthos sampling periods will be 2 months prior, 5 days after, 2 months after, and 1 year after insecticide application.

Two drift sample monitoring stations will be established on sample monitoring streams. Each drift sample will be secured in a nylon bag (30 meshes/inch) 1 meter in length that is attached to a metal frame. Organisms will be separated in the laboratory and enumerated in taxonomic groups and volumes determined by displacement in 70 percent alcohol. Drift sampling period will be continuous from 24 hours prespray until 72 hours postspray.

Wildfish (5-10) will be collected and placed in live cages 1 week prior to insecticide application. Caged fish will be observed routinely for stress and mortality resulting from the insecticide application. Caged fish will be removed at periodic intervals for residue analysis. Spray cards will be placed along streams to quantify spray deposit reaching streamside.

Insectivorous Birds[3/]

Objective: Conduct bird studies to determine (1) species diversity, (2) abundance of nesting pair density, (3) nesting success, and (4) survival on both treated and untreated plots; detect and analyze year-to-year changes whether the results are from treatment or other causes. When feasible, studies related to small mammals will be included in the planned studies.

2/Principal investigator, Gordon Haugan, Zone Fisheries Biologist, Lolo National Forest.

3/Principal investigator, Dr. Charles Henny, Wildlife Biologist, U.S. Fish and Wildlife Service, Denver, Colorado.

Methods: Nest boxes will be placed at preselected spots to attract nesting birds. The boxes will be visited and checked at routine intervals. The following measures of reproduction will be recorded: eggs laid, eggs hatched, and young fledged. Bird census lines will be run to determine all birds seen and heard for species diversity and abundance.

Forest Pollinators[4/]

Objective: Determine the effect of Sevin-4-Oil and Dylox on forest insect pollinators. If there is a decline in forest pollinators, what effect will the pesticide applications have on the forest flora.

Methods:[4/]

Spruce Budworm Parasites

Objective: Determine incidence of budworm parasitism prior to and following the application of Dipel, Sevin-4-Oil, and Dylox.

Methods: To determine effect of Dipel, Sevin-4-Oil and Dylox on incidence of budworm parasitism, 30 budworm larvae will be collected, if available, from the branches of each tree sampled during prespray and postspray sampling periods. Ten larvae will be placed per petri dish with a 1- by 2-inch piece of artificial media for rearing. Two elastic bands will be doubled around each dish to prevent larval escape. Petri dishes will be labeled as to tree number, spray block, number of larvae per dish, and sample period.

Parasite cocoons from each sample will be placed in individual gelatin capsules, then into petri dishes. These dishes will be labeled as to tree number, spray block, and sample period.

Other lepidopterous larvae found on branch samples will be reared the same as budworm larvae to determine incidence of parasitism.

All dishes containing larvae and/or parasite cocoons will be placed in well lighted areas for rearing. Rearings will yield adult moths and parasites which will be identified by specialists. Prespray and post-spray parasite data will be subjected to statistical analysis.

Residues

Objective: Measure the accumulation and degradation of Sevin-4-Oil at the rate of 1 pound active ingredient per acre. Residue samples will be collected at periodic intervals from water, fish, grasses, herbaceous

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4/Principal investigator has not been identified. Study methods will be developed by investigator.

forage, Douglas-fir foliage, and aquatic insects. *Bacillus thuringiensis* is exempt from tolerance restrictions and has no known effect on organisms other than lepidopterous larvae, therefore no residue analyses are planned for Dipel. Dylox residue accumulation and degradation data is available in western conifer forests from studies conducted in Colorado in 1974 by the Pacific Southwest Forest and Range Experiment Station, Insecticide Evaluation Project (IEP). Therefore no residue analyses of Dylox are planned.

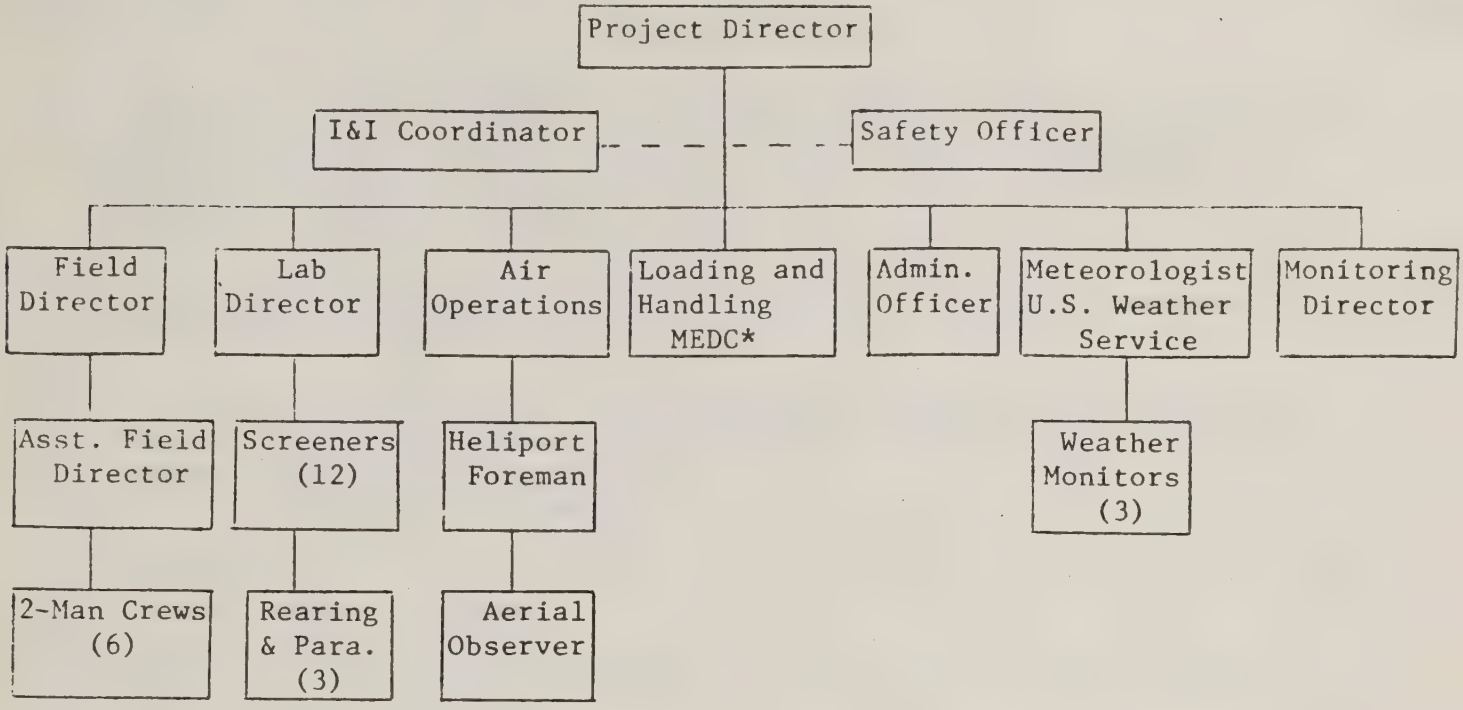
Methods: The residue analyses study for Sevin-4-Oil will use design and analyses criteria being developed by IEP for Sevin-4-Oil environmental effects studies in 1975 at 2 pounds and 4 pounds active ingredient per acre. The studies will be comparable and a sampling plan will be developed with consultation from IEP.

Data analysis and publication.--The investigator will prepare a written report that shall include all significant data, analysis, conclusions, and/or recommendations. The written report or a summary will be included in the final project report. In the event that the sample data provides worthwhile research information the investigator will have permission to publish the report with due credit to other participants involved.

ADMINISTRATION AND ORGANIZATION

Personnel from the Forest Environmental Protection Group, State and Private Forestry, Missoula, in cooperation with the Beaverhead and Gallatin National Forests, will administer the project. The chemical phase of the project will be headquartered in Ennis and the microbial phase will be headquartered in the Bozeman vicinity.

Figure 4.--Organization chart for 1975 pilot control project (Gallatin National Forest).



*Missoula Equipment Development Center

An administrative officer will be assigned by each Forest to this project. He or she will be responsible for hiring temporary personnel, contracting vehicles, purchasing necessary supplies, and timekeeping.

INFORM AND INVOLVE

The major I & I responsibility for this project has been assigned to John Hook, District Ranger, Sheridan Ranger District, Beaverhead National Forest, and William Driver, Timber Forester, Gallatin National Forest. The I & I program will insure that key individuals and the general public are informed about the project.

I & I coordinators will prepare individual action plans. Components of the plans should include:

1. Meet individually with key contacts. These may include Montana Fish and Game, conservation group leaders, university staff, key landowners, Chambers of Commerce, etc.
2. Timely news releases.
3. Make available an environmental statement or environmental analysis.
4. Public meetings.
5. Use of pictorial displays describing the problem and the proposal. These are placed in areas of considerable public exposure (banks, courthouses, etc.).
6. Tour of news media to observe project.

AIR OPERATIONS

Spraying will be done by helicopter, probably a Jet Ranger or Bell 205. Sufficient helicopters will be contracted to spray one complete plot (1,000 to 2,000 acres) on each Forest per spray day. A separate helicopter will serve as an observation ship during spraying. An aerial observer will ride in the observation ship and map spray swaths.

SAFETY

All Forest Service employees.--The safety program is the direct responsibility of the safety officer. Instructions outlined in the Forest Service Health and Safety Code Guide will be enforced. All supervisors will point out specific hazards and see that each employee follows safe working procedures. Each employee is responsible for:

1. Developing safe working habits and attitudes.
2. Assisting fellow employees in maintaining safe habits.
3. Checking vehicles each day to insure safe mechanical condition.
4. Prompt reporting and documenting of all accidents to his immediate supervisor.
5. No smoking in insecticide loading and aircraft refueling area.

Aircraft.--Safety regulations developed for use of Forest Service aircraft will be followed.

Shoulder harnesses will be worn at all times when flying in helicopters.

Emergency jettison of insecticide.--In case of emergency jettison of an insecticide load, the project coordinator will immediately notify the Washington Office Forest Pest Management, U.S. EPA, State Fish and Game Department, State Department of Health and Environmental Sciences, Regional Safety Officer, and Regional Pesticide Coordinator.

Everyone handling either the concentrate or dilute material will:

1. Be required to wear rubber gloves and clothing that will protect the body from accidental spillage.
2. Wash with soap and water as soon as possible after coming in direct contact with insecticide.
3. Not be allowed to eat or smoke while handling insecticide.
4. Wear respirator to prevent inhalation of insecticide fumes.

Only authorized personnel will carry out the loading operation. Care will be taken in removing the filler hose nozzle from spray tanks to prevent spillage of chemical on aircraft and ground. Spillage will be immediately washed off the loading area.

Accidental exposure.--If accidental exposure occurs with either of the chemicals:

1. Flush contaminated eyes with plenty of water and get medical attention.
2. If swallowed, induce vomiting by giving an emetic such as 2 tablespoons of salt in a glass of warm water. CALL A PHYSICIAN.

Dylox and Sevin-4-Oil are cholinesterase inhibitors. Atropine is an antidote. At least two physicians in Bozeman, Ennis, and Sheridan will be alerted to the pilot project, insecticides to be used and their antidote, and be prepared to administer medical assistance. Physicians names and phone numbers will be posted conspicuously at the loading facilities.

The microbial agent has shown no ill effects to warm-blooded animals.

FINANCIAL PLAN FOR 1975 SPRUCE BUDWORM PILOT CONTROL PROJECT - REGION 1

Item	Rate	Cost FY 1975	Cost FY 1976
Materials			
Dipel (On hand)			
Sevin-4-Oil	1,200 gal.* @$7.70/gal.	$ 7,219	---
Dylox	1,200 gal. @$11.50/gal.	13,840	---
Panasol AN3	4,500 gal. @$1.00/gal.	4,500	---
Fuel oil**	2,000 gal. @$.50/gal.	1,000	---
Dye (Automate Red B)	1,200 lbs. @$1.87/lb.	2,272	---
Aircraft			
Spray helicopters	13,500 acres @$4.50/acre	60,750	---
Chase helicopters	28 hours @$350.00/hour	3,000	$ 6,800
Reconnaissance helicopters	30 hours @$150.00/hour	2,250	2,250
Salaries			
Field & laboratory crews**	61 people @3.75/hour for 40 days	29,280	43,920
MEDC	4 men @$88.00/day for 12 days	1,408	2,816
Overtime**		12,200	24,350
Forest personnel (Admin. Off. etc.)**		2,750	2,750
Vehicle Rental			
Pickup trucks**	29 pickups @$13.00/day for 56 days	8,294	13,572
Per Diem**	20 men @$25.00/day for 58 days	11,000	18,000
Environmental Monitoring			
Residue analysis	166 samples @$60.00/sample	9,960	---
Biological effects:			
Parasites	4 people for 45 days plus equipment and supplies	6,500	3,500
Aquatics (fish and insects)	2 men for 80 days plus equipment and supplies	7,000	4,500
Insectivorous birds	2 men for 90 days plus equipment and supplies	10,000	5,000
Forest pollinators	1 man for 90 days plus equipment and supplies	5,000	5,000
Supplies			
Gas and oil for vehicles**		1,800	3,200
Miscellaneous**		3,300	1,000
Services			
(lab, phones, cold storage, etc.)**		1,700	3,300
Spray Deposit Assessment and Meterological Support	3,200 spray deposit cards; 2 meterologists and 2 technicians	9,870	8,130

FINANCIAL PLAN FOR 1975 SPRUCE BUDWORM PILOT CONTROL PROJECT - REGION 1

Item	Rate	Cost FY 1975	Cost FY 1976
I & I**		$ 1,500	$ 500
Computer time and publication of results		---	3,000
Regional Office Overhead 6%		12,980	9,095
National Forests Overhead 35%		20,694	29,572
(Applies only to $ allotted to Forests)		250,000	190,255
GRAND TOTAL		$440,255	

*Union Carbide contributes one-fourth of this amount.
**A portion of these include money to be allotted to Forests.

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